



## 2015 Space Weather Workshop

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Boulder, Colorado

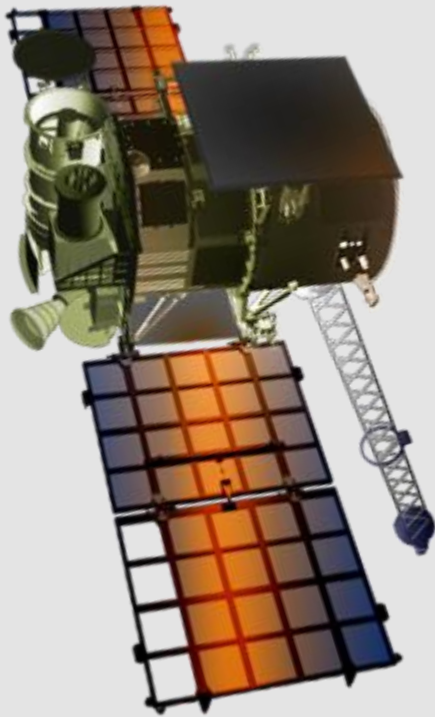
# AGENDA

- **Current Space Wx Satellite Development Status**
- **NESDIS Strategic Issues**
- **Space Commercialization**
- **Budget Overview**
- **Questions?**

# DSCOVR Status

## Deep Space Climate Observatory (DSCOVR)

- Joint NOAA/NASA/DoD space weather program which will succeed NASA's ACE mission in providing solar wind measurement continuity from the L1 orbit
- Will maintain accuracy and improve the lead time for geomagnetic storm warnings
- Provides necessary national infrastructure protection for transportation, power grids, telecommunications, and GPS
- Launched February 11, 2015, from Cape Canaveral, Florida.
- Reached halfway mark to L1 on Feb 24th
- Operational turnover of satellite command and control is June 2015.
- Turnover of Ground System Ownership is Sept 2015.





# GOES-R Series Status

- All GOES-R instruments integrated on spacecraft
- GOES-S/T/U instruments under development



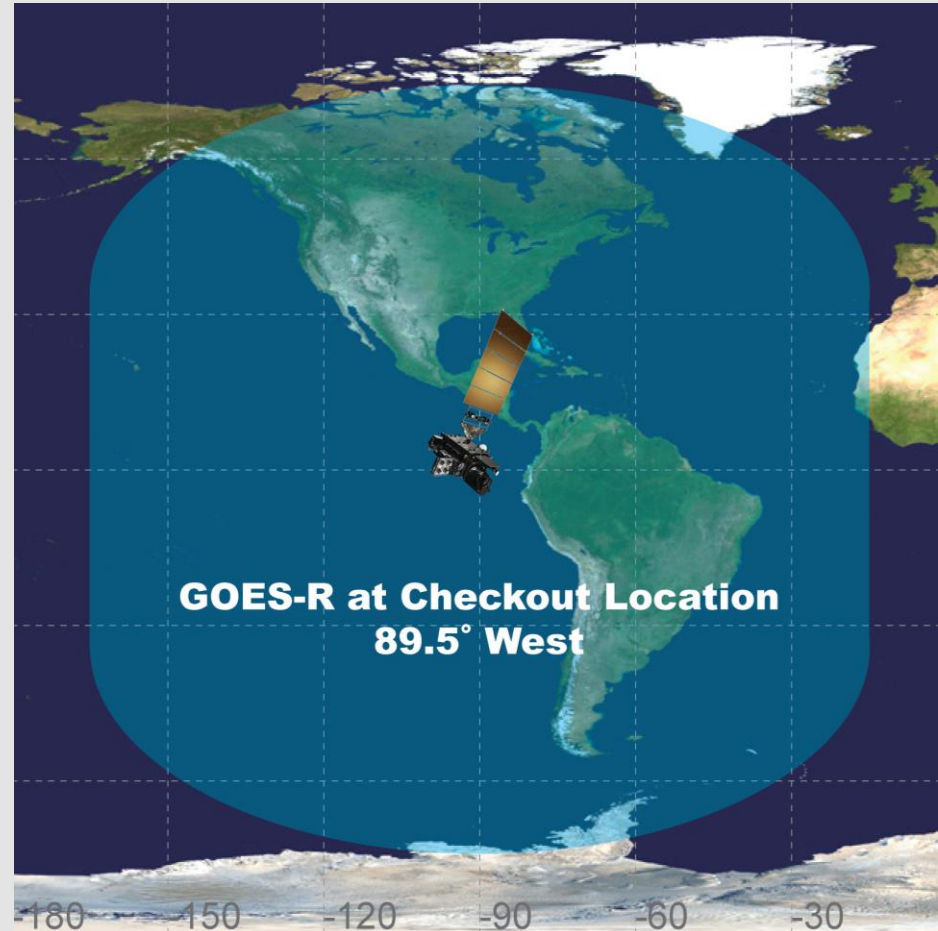
Assembled GOES-R Spacecraft



\*ABI & GLM not shown

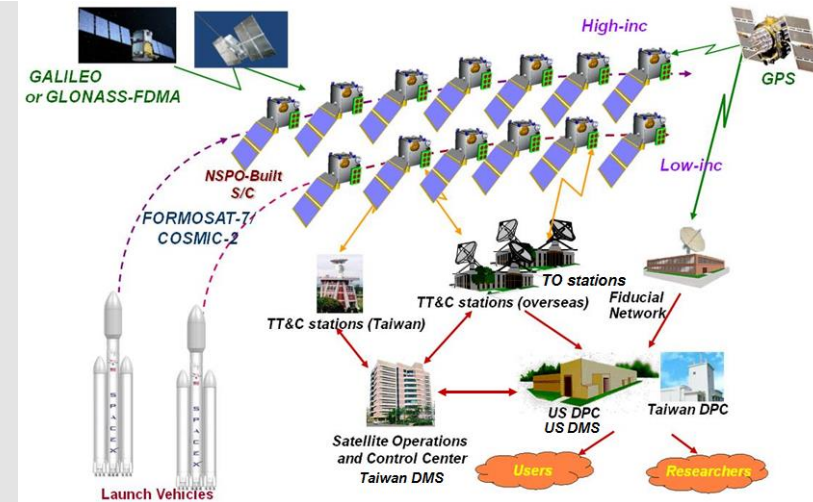
# GOES-R Launch

- GOES-R Launches in March 2016
- Launch & Orbit Raising: 12 days
- Approximate Level 1b data availability:
  - L+86 days: MAG
  - L+95 days: SUVI
  - L+107 days: EXIS
  - L+130 days: SEISS
- GOES-16 Extended Validation: Sept 2016  
– March 2017
- GOES-16 Operational: March 2017 at TBD orbit location



# COSMIC-2

- COSMIC-2 is the follow-on to the current COSMIC mission
- System will provide 10,000+ worldwide soundings per day with 30 min average latency
- Instruments
  - **TriG GNSS-RO receiver (TGRS)** - Radio Occultation (RO) receiver used for weather prediction and space weather monitoring
  - **Ion Velocity Meter (IVM)** - Measures the in-situ plasma density, ion temperature and composition, and drift velocity;
  - **RF Beacon** - Transmitter that enables ground-based measurement of ionospheric scintillation and ionospheric total electron content (TEC);
- 12 Satellite Constellation in two inclinations
  - C-2a – Launch in 2016: 6 satellites to 24 degree orbit
  - C-2b – Launch in 2018: 6 satellites (+ 1 optional spare) to 72 degree orbit



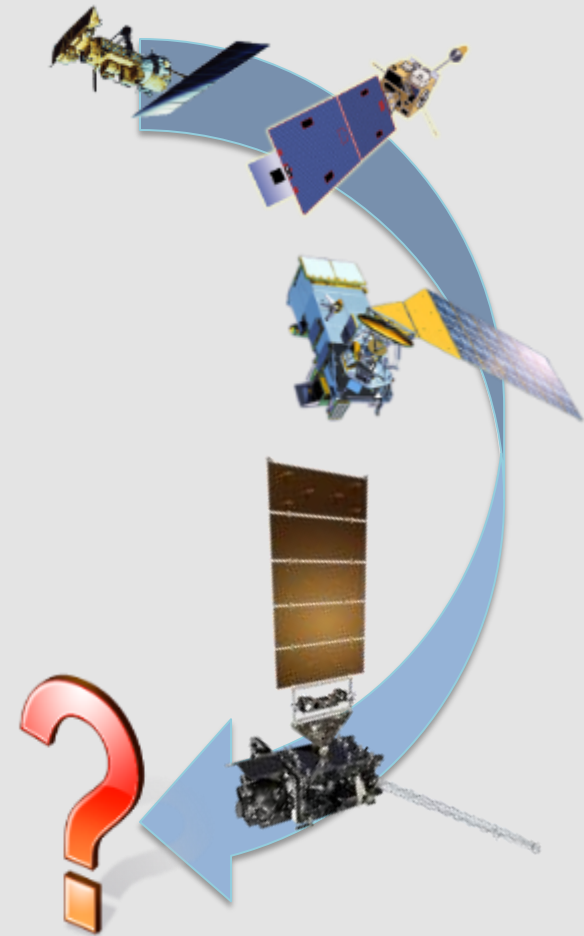


# NESDIS Strategic Issues for the Future

- NESDIS Reorganization, including merger of the three Data Centers into a single organization
- Evolution of the ground systems and operations
- Defining the architecture for our future systems, for both Earth and Space Weather

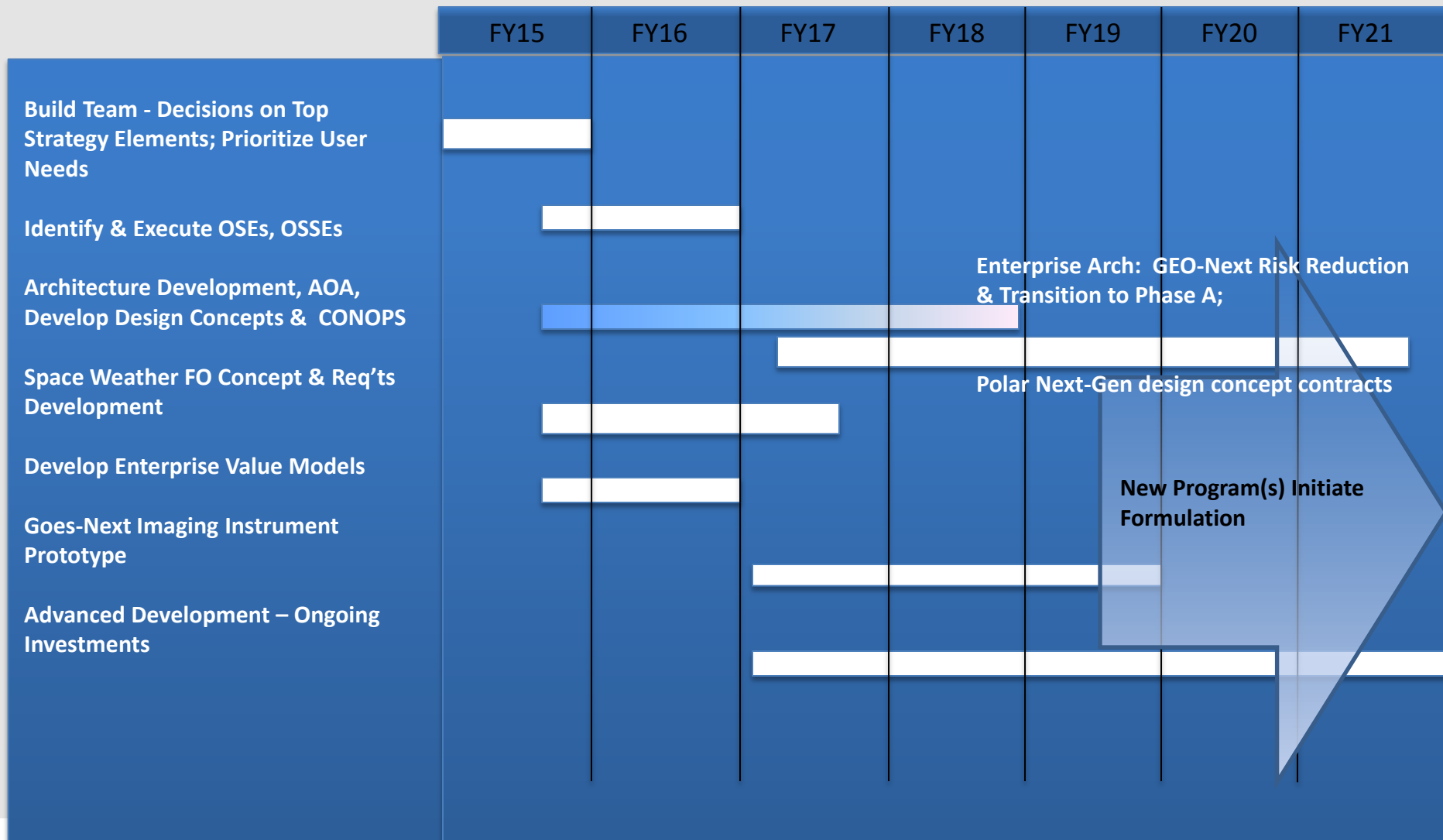
# Future Observational Architecture: One Mission, But Beyond Two Orbits

- The “polar satellite” LEO perspective is expanding...
  - COSMIC-2 RO mission: 1<sup>st</sup> six satellites launching in 2016, 2<sup>nd</sup> six targeted for FY2019
  - Earth Observing Nanosatellite-Microwave (EON-MW)
- The GEO platform geometry may be changing as well
  - Potential use of hosted payload opportunities
- The Space Weather observing system could be disaggregated over several platforms, ground, GEO, and interplanetary
- For all, commercial possibilities may emerge to supply some of NOAA’s data needs and must be considered
- Implementation characteristics for architecture studies
  - Comprehensive
  - Requirements driven
  - Affordable
  - Traceable & transparent





# Architecture Work: A Preliminary Schedule



# Space Commercialization

## Policy

- **NOAA Commercial Data Policy** to guide the use of space-based commercial data and services to meet NOAA requirements
- **NESDIS Commercial Space Process** will define how NESDIS engages with the commercial sector to leverage commercial solutions for space-based earth observation requirements
- Both are in review in the Administration, expected release 2015.

## Engagement through RFIs

- **RFI on solar wind data released in January 2014:** Although there is no current service, there continues to be interest and capability in the private sector for providing such data
- **RFI for A-DCS/SARSAT hosting opportunity released in August 2014:** Will be using Air Force HoPS contract to examine LEO hosting opportunities for key instruments
- **RFI on GNSS-RO commercial capabilities released in September 2014**
  - Goals were to understand the range of options available to purchase commercial radio occultation data and evaluate the current capabilities of potential suppliers
  - NOAA will continue to explore commercial RO solutions in conjunction with existing RO capabilities

# Requirements Workshop

- NESDIS is holding workshop with industry and the public to discuss our requirements processes along with our approach for using data from commercial sources.
- The Workshop will be held on April 28th, 2015 at the National Center for Weather and Climate Prediction, College Park, MD from 1:00p-4:30p
- If interested in attending, you can register for the workshop at: [http://www.nesdis.noaa.gov/April\\_workshop/](http://www.nesdis.noaa.gov/April_workshop/)

# FY2016 Budget Overview

- Maintains 24x7 satellite operations, product development, processing & distribution
- Supports upcoming Jason-3, GOES-R, JPSS-1 launches
- Supports the operations and maintenance of NOAA's long-term safe archival storage capacity and access to preserved climatological, oceanographic and geophysical data
- Includes funding for the Polar Follow On, **Space Weather Follow On**, and COSMIC-2 second set of sensors
- Accommodates continued operations and planning for additional A-DCS and SARSAT instruments
- Enables continued development of systems engineering and enterprise ground capabilities supporting OSGS, OSAAP, OPPA
- Provides support for Data Center Operations and Big Earth Data Initiative



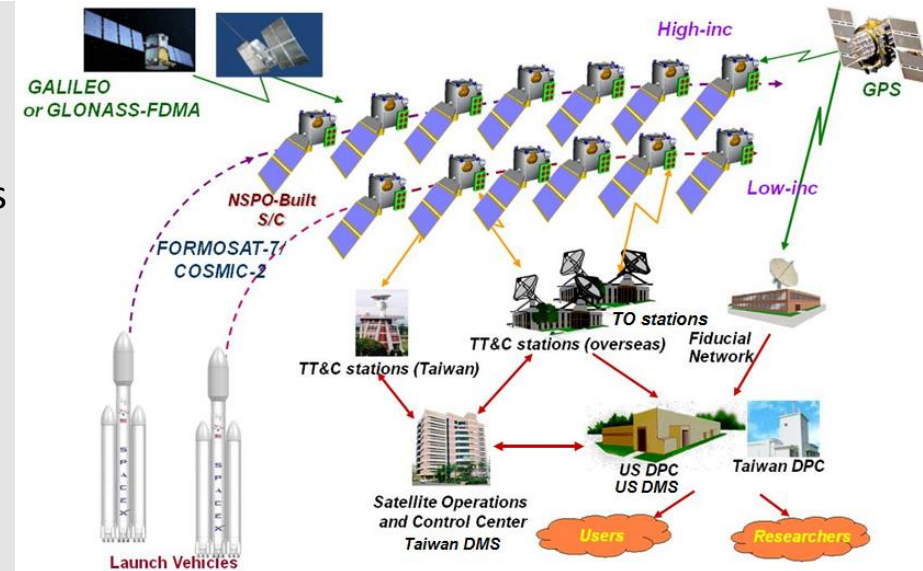


# Questions?



# COSMIC-2 Background

- COSMIC-2 is the follow-on to the current COSMIC mission that was launched in 2006
- System will provide 10,000+ worldwide soundings per day
- All weather, uniform coverage over oceans and land with 30 min average latency
- 12 Satellite Constellation, 2 launches in different inclinations
  - C-2a – Launch in 2016: 6 satellites to 24 degree orbit – carries TGRS primary mission payload and two USAF secondary payloads Ion Velocity Meter and Radio Frequency Beacon
  - C-2b – Launch in 2018: 6 satellites (+ 1 optional spare) to 72 degree orbit – carries Taiwan secondary payloads (planned)



# COSMIC-2 Payloads

- TGRS
  - Radio Occultation (RO) receiver that tracks GNSS signals across Earth's limb
  - Weather prediction models, severe weather forecasting, and space weather monitoring
  - Meteorological, ionosphere and climate research
  - Provides global observations of refractivity, pressure, temperature, humidity, total electron content, ionospheric electron density, and ionospheric scintillation
- IVM
  - Measures the in-situ plasma density, ion temperature and composition, and drift velocity
  - Used for modeling the ionosphere to determine electric fields that could impact other systems (e.g. GPS radio signals)
- RF Beacon
  - Transmitter that enables ground-based measurement of ionospheric scintillation and ionospheric total electron content (TEC)
  - Critical to the understanding of the impacts of space weather on satellite communication systems and GPS

# COSMIC-2 Status

- System End-to-End Test (SEET) occurred at the end of Feb, Flight Acceptance Review was the first week of March, and the delivery of the first two satellites to Taiwan occurred at the end of March
- All first flight units for TGRS, IVM, and RF Beacon were delivered to SSTL and successfully powered through the spacecraft
- INPE (Brazil's Space Agency) successfully conducted Factory Acceptance Testing (FAT), successfully ingested COSMIC-1 data. Antenna being shipped from the factory in France to the ground site in Brazil. Initial UCAR quality analysis indicates good performance in FAT.
- Active dialogue with Australia's Bureau of Meteorology (BoM) – they are willing to host a ground station at their site in Darwin
- The USAF Mark IVB support: On December 9, 2014, the USAF Acting Director of Weather sent NOAA a letter stating that the USAF, “decided to fund the upgrade and sustainment costs associated with this effort within our existing program.”
- FY15 budget will allow NOAA and UCAR to complete C-2a Data Processing Center (DPC) development and testing
- FY16 President's Budget contains NOAA's requested amount for C-2a ground activities, as well as the second six mission payloads for C-2b
- All segments are making positive progress and the program is moving towards Program CDR in May 2015 with Launch #1 in 2016.
- Taiwan and the US are actively pursuing the second launch of 6 (+1) satellites.



# FY16: Space Weather Follow-On

(\$ in millions)	FY 2014 Spend Plan	FY 2015 Enacted	ATBs	FY 2016 Base	Program Changes	FY 2016 Submit
Space Weather Follow-On (PAC)	\$0.0	\$0.0	\$0.0	\$0.0	\$2.5	\$2.5

## What

- With this increase, NOAA will analyze options from the Analysis of Alternatives (AoA) for critical space weather observations and initiate development of the Space Weather Follow-On mission.

## Why

- Geomagnetic storms can have calamitous consequences for the U.S. economy and human safety.
- Solar storms with the potential to impact important elements of our Nation's infrastructure can occur over 100 times during a solar cycle.
- Solar wind data are the sole input for short-term warnings (15-60 minutes) of geomagnetic storms. Coronal mass ejection (CME) imagery is the model input for the 1-4 day warnings of geomagnetic storm conditions.

## Impact

- Funding is requested to ensure space weather data continuity following the expected end of life of the DSCOVR mission in FY 2019